Physics of Musical Sound

Class 12

Read Chapter 8

Quiz!

Pitches and Scales

- A scale is a set of (usually) 7 notes chosen from the 12 possible notes and arranged in order of increasing frequency.
- The simplest scale in common western use is called the diatonic major scale. Its simplest form is the set of notes
  C D E F G A B C
  called the diatonic scale on C.
- Other common scales include the rising and falling forms of the diatonic minor scale, the harmonic minor scale, and the chromatic scale.

Western Pitch Choices

- Each individual pitch is given a name consisting of a single letter of the alphabet possibly with a modifying adjective (sharp or flat).
- Two pitches that are 1 octave apart are always given the same name.
- The octave interval is split into 12 identical frequency intervals chosen so that the ratio of two successive notes is $\sqrt[12]{2} = 1.059463094\ldots$.
- Each such interval is called 1 semitone.

Western Musical Notation

- Any scheme that can accurately represent music must convey not only the pitch of each note but also its time of starting and duration.
- The standard scheme is essentially a 2-D plot in which time runs along the horizontal axis and pitch along the vertical axis.
- The vertical axis is drawn on a set of lines called a staff and each line and space on the staff is assigned to a unique note.
  - Several different mappings are in use and a symbol must drawn at the start of each line of music to identify the mapping.

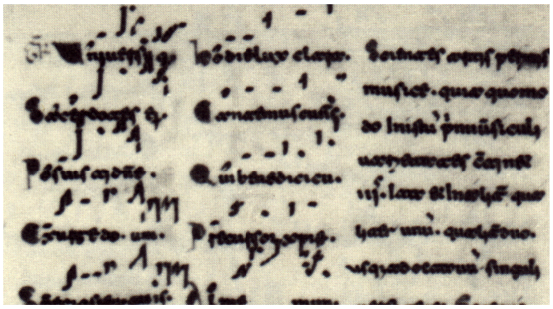
Western Pitch Names

- The 12 semitones that make up 1 octave are assigned note names using the following curious scheme.
  A A#/Bb B C C#/Db D D#/Eb E F F#Gb G G#/Ab A
  - Note that five of the notes have modified names and each one has two different forms, a sharp (#) form and a flat (b) form.
- The scheme is historical in origin and we shall study its origins in more detail later.
- The complete set of 12 distinct pitches make up the chromatic scale.

Western Musical Notation

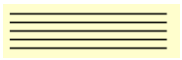
- Can denote lists of pitches using only letter names.
  - Classical Greeks had a notation system involving listing letters for notes.
  - Some European vocal music notated in solfa notation with letters.
- Earliest form of modern notation appears in first millenium to note ways of singing sacred texts. Uses little squiggles called neums written above the text.

Neums



Western Musical Notation

- Over time settled on a staff of five lines



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- By the 12th century lines were added behind the squiggles to make pitches precise.

Western Musical Notation

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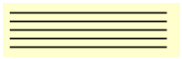
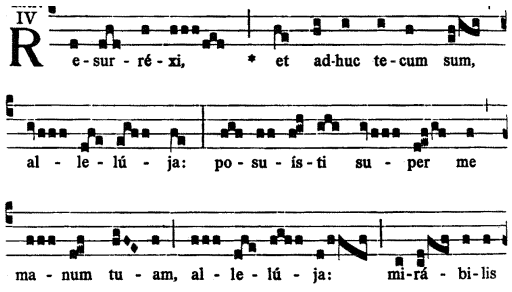


- Each line and each space corresponds to one note of the diatonic scale.

Plainchant



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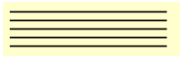

- Each line and each space corresponds to one note of the diatonic scale.
- Even using the space above and below the staff can only represent 11 notes without adding extra lines (ledger lines) and even vocal music needed more.

Western Musical Notation

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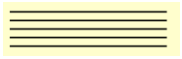


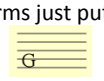
- Each line and each space corresponds to one note of the diatonic scale.
- Even using the space above and below the staff can only represent 11 notes without adding extra lines (ledger lines) and even vocal music needed more.
- Can get more if start staff in different places!

Western Musical Notation

- Most common forms today are treble clef and bass clef.
- Commonly use mnemonic words or phrases when learning notation. Mine are English.
  - In the treble clef
    Lines: Every Good Boy Deserves Favours.
    Spaces: F A C E

Western Musical Notation

- Need to markers to show which line is which. First forms just put note letter on line.



- By 16th Century letters became stylized to clefs

Treble Clef

Bass Clef

One form of C clef

Western Musical Notation

- Most common forms today are treble clef and bass clef.
- Commonly use mnemonic words or phrases when learning notation. Mine are English.
  - In the treble clef
    Lines: Every Good Boy Deserves Favours.
    Spaces: F A C E

  - In the bass clef
    Lines: Good Boys Deserve Favours Always
    Spaces: A C E G and I cant remember a mnemonic!

Western Musical Notation

- Most common forms today are treble clef and bass clef.

Western Musical Notation

- By itself the staff can only represent the white notes on the piano. To represent others we add modifying symbols called accidentals.
  - ♭ a flat, lowers the pitch by one semi-tone from its written value.
  - ♯ a sharp, raises the pitch by one semi-tone from its written value.
  - 𝄫 a double flat, lowers the pitch by a whole tone.
  - 𝄪 a double sharp, raises the pitch by a whole tone .
  - ♮ a natural removes a previous accidental
- Music written in keys other than C require certain notes always be raised or lowered. Instead of putting accidentals on each note the accidentals are shown at the start of each line of music as a key signature.

Western Musical Notation

- Staff is a 2-D graph of pitch against time.

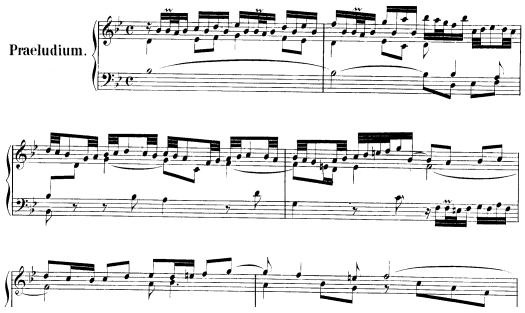
Western Musical Notation

- Over time shorter and shorter notes were added to the repertoire until by the 18th Century modern forms were stable. These begin with the longest of the old forms, the breve, and work down.
  - 1 Breve = 2 Whole Notes or Semi-Breves
  - 1 Whole Note = 2 Half Notes or Minims
  - 1 Half Note = 2 Quarter Notes or Crotchets
  - 1 Quarter Note = 2 Eighth Notes or Quavers
  - 1 Eighth Note = 2 Sixteenth Notes or Semi-Quavers
  - You can keep going by adding more tails if you realy want to!

Western Musical Notation

- Staff is a 2-D graph of pitch against time.
- Early notation little more than blobs on the lines. Over time different note shapes adopted to denote different durations of notes.

Bach Partita



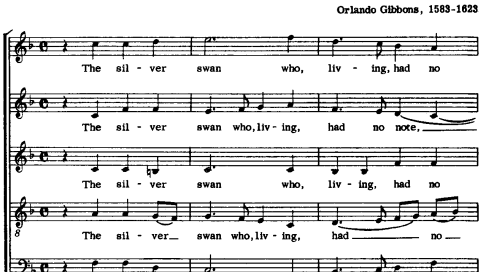
Western Musical Notation

- Staff is a 2-D graph of pitch against time.
- Early notation little more than blobs on the lines. Over time different note shapes adopted to denote different durations of notes.
- The oldest music in staff notation used only two basic symbols, a long note, 𝄋 called a longa, and a short note, 𝅜 called a breve.

Rhythm Notation

- Rhythm is the medium scale temporal structure of music--the patterns of stress and unstress that correspond to the meter of poetry.
- Earliest notated music gave note values but only indication of rhythm was the underlying text.
- By the 15th Century three patterns dominated
  - Groups of 4 beats stressed S w s w S w s w … called common time and denoted at the start of the music by a stylized letter C, 𝄴.
  - Groups of 3 beats stressed S w w S w w … called perfect time and denoted at the start by a circle, O.
  - Groups of 2 beats stressed S w S w … called cut time and denoted by the symbol 𝄵.

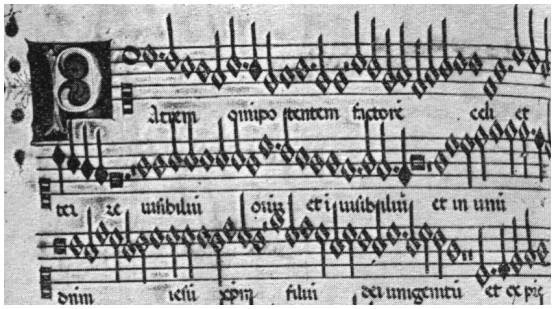
Common Time



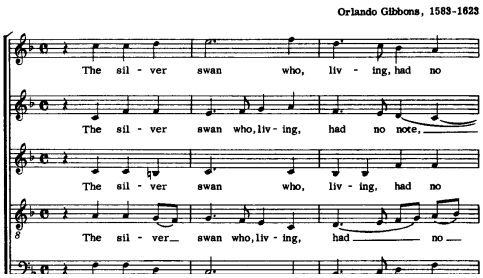
Modern Rhythm Notation

- Around 1600 musicians took to marking the rhythmic groups by drawing lines down the staff, dividing the music into measures or bars.
- The simple symbol time signatures were replaced or augmented by numeric signatures written as two numbers, one over the other
  - n the number of principle beats in a measure
  - m the length of the beat (4=quarter, 2=half, etc.)

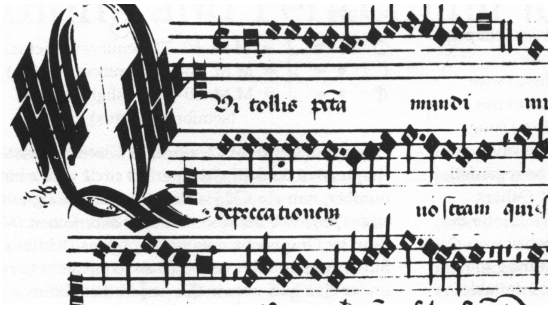
Tempus Perfectus



Common Time



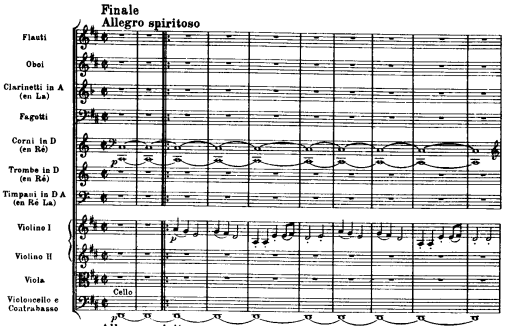
Cut Time



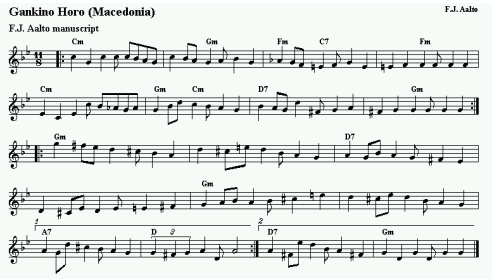
Modern Rhythm Notation

- Some common time signatures
  - 4/4 Four quarter note beats to the measure; the old common time. This is familiar from marches, hymns, and many other forms.
  - 3/4 Three quarter note beats to the measure; the old perfect time. This is the time signature for waltzes and minuets.
  - 6/8 Six eighth notes to the measure. A compound time that can be grouped as two groups of 3 or three groups of 2.
- and some more exotic ones
  - 12/8 Twelve eighth notes to the measure. For example Beethoven's Sonata Appassionata.
  - 5/4 Five quarter notes to the measure. Exotic sounding rhythm that has its origins in Eastern Europe. E.g. Tchaikovsky's 6th.
  - 7/4 Seven quarter notes to the measure. Even more exotic rhythm again with Eastern ties. E.g. Bernstein Chichester Psalms.

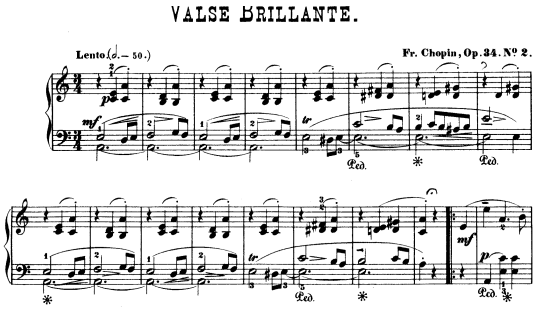
Haydn London Symphony



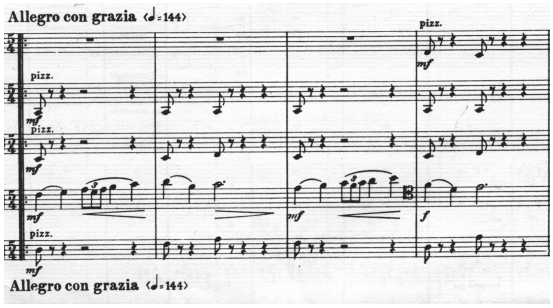
Macedonian Dance



Chopin



Tschaichovsky 6th



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